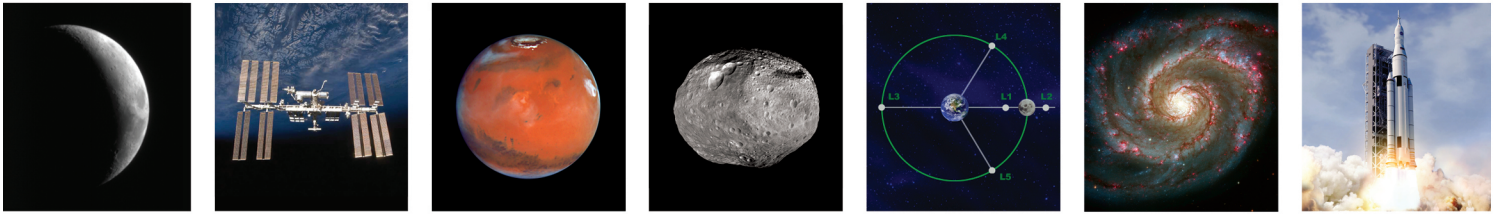




Space Launch System

Highlights

May 2013



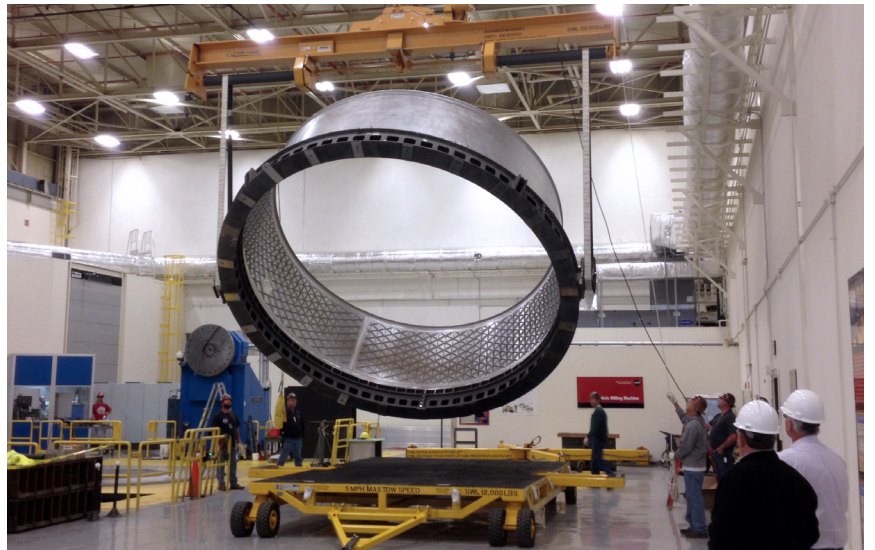
Adapter ‘Flips’ for Progress toward 2014 Exploration Flight Test

Engineers at NASA’s Marshall Space Flight Center in Huntsville, Ala., recently flipped an adapter—no easy feat when you’re talking about 1,000 pounds of aluminum—furthering progress toward Exploration Flight Test 1 (EFT-1) in 2014 and providing early experience for Space Launch System (SLS) hardware ahead of the rocket’s first flight in 2017.

The flip is an important step in finishing the machining work on the adapter, which will attach NASA’s Orion spacecraft to a United Launch Alliance (ULA) Delta IV rocket that will send Orion to space during EFT-1.

The same adapter technology later will connect Orion to SLS—a new heavy-lift rocket managed and in development at Marshall that will be capable of sending Orion into deep space.

During EFT-1, Orion will travel to an altitude of approximately 3,600 miles above Earth’s surface. By flying Orion out to those distances, NASA will be able to see how the spacecraft performs in and returns from deep space



The structural test article adapter is flipped at Marshall testing facility Building 4705. The turnover is an important step in finishing the machining work on the adapter, which will undergo tests to certify subsequent flight units used to attach the Orion spacecraft to a Delta IV rocket for its 2014 Exploration Flight Test-1. *(Image: NASA/MSFC)*

journeys. The flight test also will provide engineers with important data about the adapter’s performance before it is flown on SLS.

Engineers finished welding the first of two adapters and flipped it using a Posi-Turner load rotation device and an Assembly Jig, the ring that connects the Posi-Turner to the bottom of the adapter and rotates it.

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Adapter Flip

(continued from page 1)

“The Posi-Turner and Assembly Jig were repurposed from another program, so we had to modify them a bit to fit our needs to rotate the adapter,” said Brent Gaddes, Spacecraft & Payload Integration Adapter Subsystem manager at Marshall. “Our engineers are really good at coming up with creative ways to use existing resources in a cost-effective manner.

“Affordability is crucial when you’re talking about building a rocket as big and powerful as the Space Launch System,” added Gaddes.

“It’s very exciting as a young engineer to be able to work on a piece of flight hardware, and see it go from design to actual manufacturing,” said Zenia Garcia, a Marshall engineer who worked on the design for fitting the adapter to the Assembly Jig and Posi-Turner tooling. “I’ve had the opportunity to exercise my technical expertise, as well as get hands-on experience on this project. I look forward to seeing that work take Orion, and SLS, to space in the near future.”

Now that the adapter is flipped and positioned on a seven-axis mill turntable at one of Marshall’s manufacturing facilities, engineers will drill hundreds of holes in it for bolting to the rest of the rocket. ULA, which makes the Delta IV in nearby Decatur, Ala., will deliver a full-size section of the rocket in late June for engineers to test the fit of the adapter.

Circumferential welding also was recently completed on a second adapter, which will fly on EFT-1. That adapter will be moved from another Marshall manufacturing facility to the Assembly Jig/Posi-Turner for its own flip and final machining work.



NASA Associate Administrator Robert Lightfoot gets a first-hand look at the adapter work underway at Marshall’s Building 4705 on May 22. While at the facility, Lightfoot held a press conference to discuss the hardware and answer questions about the status of SLS. (Image: NASA/MSFC)

So why have twin adapters?

“It’s always important to test something before it actually flies,” said Gaddes. “Analysis on the first adapter, which we are using as a structural test article, gives us a good indication of the amount of stress it can handle, and the test verifies that the analysis is correct. We can resolve any issues with the first adapter to perfect the second piece for flight.”

The adapters, along with other SLS components, are currently under evaluation at the Spacecraft & Payload Integration Office preliminary design review, which kicked off May 15. The review is a precursor to the overall SLS program preliminary design review, scheduled to kick off June 18-19.

Click [here](#) to watch a video of the adapter ring flip.

SLS Booster Center Segment Delivered to Utah Test Bay



The center segment for Qualification Motor-1 (QM-1), a full-scale version of a solid rocket booster for the Space Launch System (SLS), was delivered May 1 to its test bay at ATK's facility in Promontory, Utah. The five-segment booster is the largest, most powerful solid rocket booster ever built for flight. ATK is the prime contractor for the boosters and the booster avionics system. A test firing of QM-1 is scheduled for late 2013, and the booster assembly is on track to support SLS's first flight in 2017. (Image: ATK)

Spaceflight Partners: Votaw Precision Technologies

EDITOR'S NOTE: Every month, SLS Highlights turns the spotlight on one of the industry partners helping to create the largest rocket ever built for human space exploration. In this issue, we profile Votaw Precision Technologies of Santa Fe Springs, Calif.

It's the little things that matter, and nobody knows this in the aerospace industry better than Votaw Precision Technologies. The 1960s-born company has played a substantial part in nationally significant projects, such as specialized production tooling for the space shuttle solid rocket boosters and pusher sleds for test rockets.

The manufacturing and machining company is small in size—it employs a little more than 130 workers—but it is known for paying very close attention to the most microscopic of details in all of its customers' needs, including those of its prime contractor, ATK of Promontory, Utah. ATK even nominated Votaw for a Small Business Subcontractor of the Year Award (Prime Contractor Subcontractor category) in the Advocates Awards ceremony in 2008 for providing exceptional contributions to the Ares I.

One of Votaw's more recent projects includes providing flight components and tools to ATK for the Space Launch System (SLS) Program. ATK is the prime contractor for the boosters and the booster avionics system for SLS. Votaw provides metal nose inlet housings, forward exit cones, throat support housing, and forward end rings for the SLS solid rocket boosters.



A Votaw employee works on a throat support housing unit that will be used on the boosters for NASA's Space Launch System. (Image: Votaw)

Showing just how precise it can be, of the 32 nose inlet housings Votaw has provided ATK for space shuttle reusable solid rocket motor (RSRM) Crew Launch Vehicle pathfinders, as well as the Ares and SLS programs, all have been defect-free. This is impressive, since there are more than 1,700 critical close-tolerance attributes associated with machining just one.

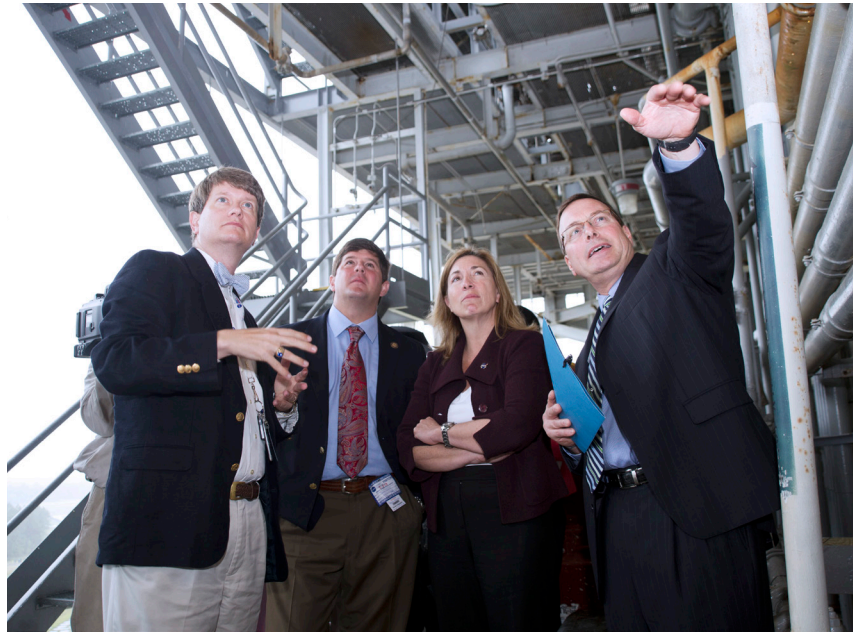
Of the 29 throat support housings that Votaw has shipped to ATK—each with more than 1,200 critical-close tolerance machining attributes—all but two were shipped defect-free. Machining operations include 14 Vertical Turning Lathe operations, 10 drill station and drill jig operations, and six horizontal boring mill operations.

Deputy Administrator Garver Visits NASA's Gulf Coast Facilities

On May 3, NASA Deputy Administrator Lori Garver visited NASA's Michoud Assembly Facility in New Orleans and testing facilities at the agency's Stennis Space Center in Bay St. Louis, Miss.

The facilities are critical to the construction and testing of NASA's Space Launch System (SLS) and Commercial Crew Program. Michoud and Stennis also are important to partnerships with private industry, which is helping maximize the use of NASA facilities.

While at the Michoud facility, Garver observed progress being made to support the SLS and Orion spacecraft programs. At Stennis, Garver toured several commercial crew testing facilities and the B-2 test stand, which is being restored in preparation for testing of the SLS core stage.



From left, Tom Jacks, B-2 test stand design lead; U.S. Rep. Steven Palazzo of Mississippi's 4th District; NASA Deputy Administrator Lori Garver; and Stennis Space Center Director Rick Gilbrech tour the B-2 test stand at Stennis. The stand is being restored in preparation for testing of the SLS core stage. (Image: NASA/SSC)



NASA Deputy Administrator Lori Garver, center, with other members of NASA and Michoud Assembly Facility management, tours Michoud's Orion Multi-Purpose Crew Vehicle (MPCV) manufacturing area. The Orion MPCV team has produced two capsule structures to date—the ground test article which is used for tooling checks and testing, and the Exploration Flight Test 1 (EFT-1) article. EFT-1 will launch in 2014. Both structures are at NASA's Kennedy Space Center in Florida. The Orion team is currently manufacturing carbon fiber components for the Launch Abort System (LAS) and panels used in the service module assemblies. (Image: NASA/MAF)

Flight Software Development Units for SLS Core Stage Delivered to Marshall

The Space Launch System (SLS) avionics team at NASA's Marshall Space Flight Center in Huntsville, Ala., has received all six of the Core Stage Flight Computer Development Units from The Boeing Company of Huntsville—the prime contractor for the SLS core stage, including avionics. The units will be used to develop the flight software for the SLS. The flight software development and testing has begun at Marshall's Software Development Facility (SDF) in an effort to rapidly mature and ensure implementation of a safe and highly reliable avionics and software system.

(Image: NASA/MSFC)



The SLS avionics team includes Boeing engineers Chris Martin, far left, and Greg Martin, standing at center; and Marshall Center engineers, seated from left, Lisa Coe, Ken King and John Weir. (Image: NASA/MSFC)

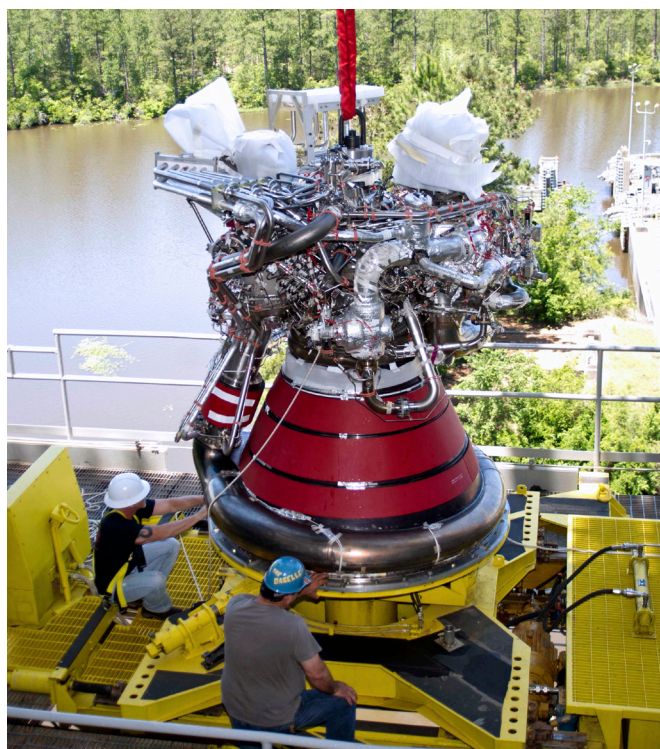


A-1 Test Stand Houses First Full Engine in Nearly a Decade

Engineers installed J-2X engine E10002 in the A-1 test stand at NASA's Stennis Space Center in Bay St. Louis, Miss. The installation is in preparation for a new series of tests, where the engine will be gimbaled, or pivoted, during test firings.

Gimbal tests are an important part of the design process. When this upper stage engine is used in space, it will need to be able to move freely to steer NASA's Space Launch System (SLS). This is the first full engine to be installed in the A-1 test stand in almost a decade and the first time gimbal tests will be performed since testing on the space shuttle main engines.

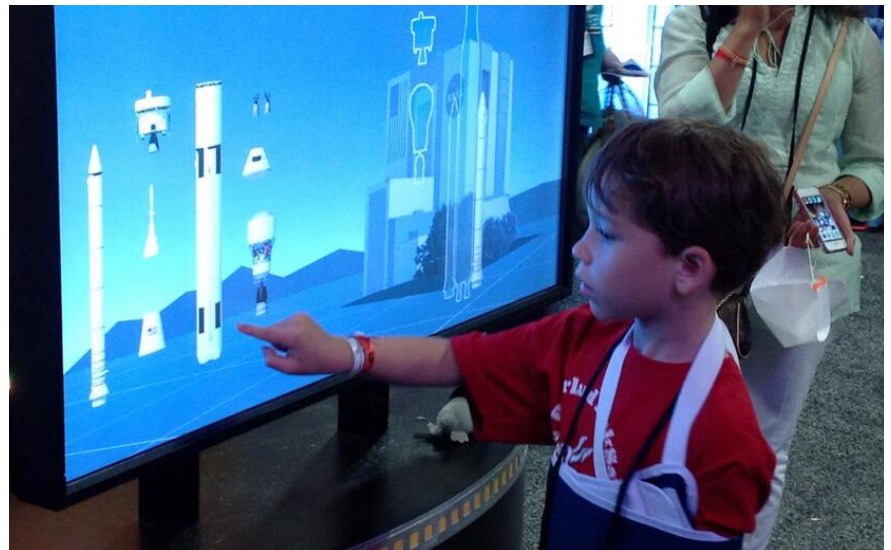
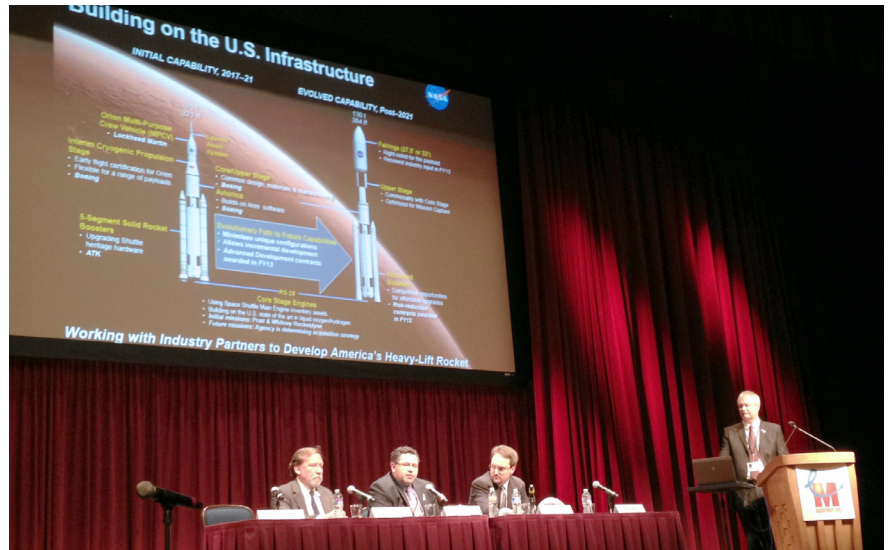
A series of tests was completed on the E10002 engine in the A-2 test stand prior to its installation on the A-1 test stand at Stennis. Once this series of tests is complete, the engine will be removed, and preparations will be made to begin testing the RS-25 engine on the A-1 stand in 2014. RS-25 engines from the space shuttle inventory will power the core stage of SLS, while the J-2X engine will power the upper stage of the evolved launch vehicle. The J-2X engine is being built by Pratt & Whitney Rocketdyne of Canoga Park, Calif.



Engineers install J-2X engine E10002 in the A-1 test stand at NASA's Stennis Space Center. (Image: NASA/SSC)

SLS On the Road...

The Humans 2 Mars Summit, held May 6-8 at George Washington University in Washington, addressed the major technical, scientific, and policy-related challenges that need to be overcome to send humans to Mars by 2030. Speaking on the Mission Architecture and Transportation panel at the summit are, from left, Doug Cooke, owner of Cooke Concepts and Solutions in Gettysburg, Pa., and former associate administrator of the Exploration Systems Mission Directorate at NASA Headquarters in Washington; Todd May, manager of the Space Launch System (SLS) Program at NASA's Marshall Space Flight Center in Huntsville, Ala.; and Josh Hopkins, a space exploration architect from Lockheed Martin Corp. of Bethesda, Md. (Image: NASA)



A participant builds the Space Launch System (SLS) at the global finals of Destination Imagination, a nonprofit organization that aims to help children discover their creativity, while incorporating science, technology, engineering, and mathematics (STEM), through different challenges. The SLS Education and Public Outreach (EPO) team provided hands-on education activities to engage and inspire the next generation of explorers at the finals, held May 22-25 in Knoxville, Tenn. More than 1,200 teams from across the world participated in the event. (Image: NASA/MSFC)

For more SLS news, updates and resources, visit www.nasa.gov/sls

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SLS on Deck:

- SLS Preliminary Design Review Kickoff
- J-2X E10002 Engine Test
- NASA-Worcester Polytechnic Institute Sample Return Robot Challenge
- Kennedy Space Center Visitor Complex Grand Opening
- Exploration Systems Progress Event at Michoud/Stennis